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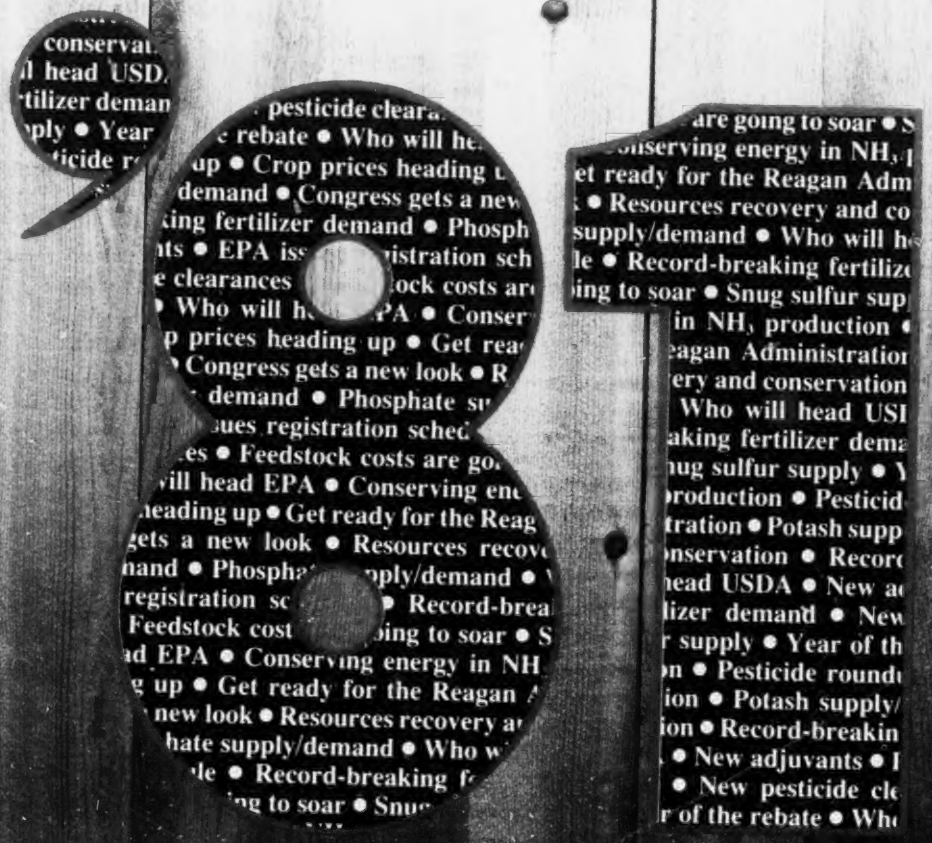
OUTLOOK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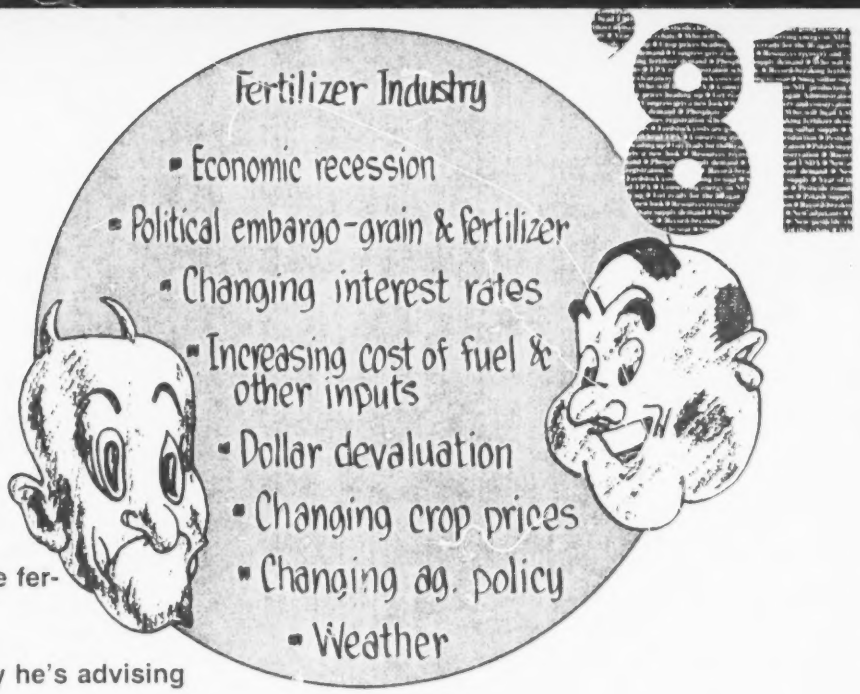
THE COVER STORY

Outlook '81—that's the theme of this special issue, and the outlook for the most part is a good one. A record-breaking fertilizer year seems in the making, and TVA's John Douglas is advising manufacturers to "produce every ton you can." There's optimism in Washington about the new Secretary of Agriculture, John Block, who looks at agriculture as "the great American weapon." On the pesticide side, more than 300 products are featured in our annual Pesticide Roundup. Be certain to read "The Year of the Rebate" on page 36 for some pros and cons on current marketing strategies of some suppliers. As the editorial points out, "1980 was a very strange year." We look for 1981 to be different.



There's no denying John Douglas' optimism about the fertilizer market for '81. In this exclusive interview, the TVA economist tells why he's advising companies to

"Produce Every Ton You Can. It Will Be Used!"

Dr. Douglas, how is fertilizer demand shaping up?

This is going to be an exciting year. There are many things that foretell nothing but good for the U.S. farmer—and for the fertilizer industry.

The world is using more total grain than it produces. It is clear that we used more last year than we produced. For the coming year, if we use what could be expected, we will use appreciably more than we produced this past year. The marketing year ended in October with much smaller grain reserves than we had when we started—some 13% smaller. Total grain carryover during the current year is expected to drop an additional 20%.

U.S. coarse grain supplies will drop to 40% of what they were at the beginning of the marketing year. World coarse grain supplies will drop from about 90 million metric tons to a level of slightly above 55 million. Coarse grain inventory carryover will probably be lower than it was anytime during 1973 or 1966, the years of severe shortages. Until we get additional coarse grain production, there will be increasing pressure on supplies of corn, sorghum, and other coarse grains. And when you have that kind of pressure, you can expect nothing but prices to go up.

Weather in the summer and fall of 1980 seriously reduced crop production and has had mixed effects upon our agriculture. It has meant that many farmers have been devastated by crop losses; on the other hand, it has had the effect of leading to rapidly escalating prices for the crops. The increasing crop prices bode well for increased fertilizer use during 1981.

Looking at corn, how does the crop/fertilizer price ratio stand now?

The price ratio corn to nitrogen is better than at anytime since 1974; much better and improving daily. The ratio on phosphate is equal to the best ratio since 1974, and it's also improving. The ratio on potash is still good.

In the spring of 1980 it took almost 100 bushels of corn to buy a ton of ammonia or urea. With the changing prices on corn and nitrogen, by August this had decreased to less than 70 bushels. Since then the ratio has improved even further.

The same is true with wheat. By August, advances in wheat prices had improved the ratio 20% as compared to spring 1980. Since then the price of wheat has continued its slow but steady upward trend, and the price of nitrogen certainly has not increased.

And with cattle and cotton these price ratios are approaching all-time records.

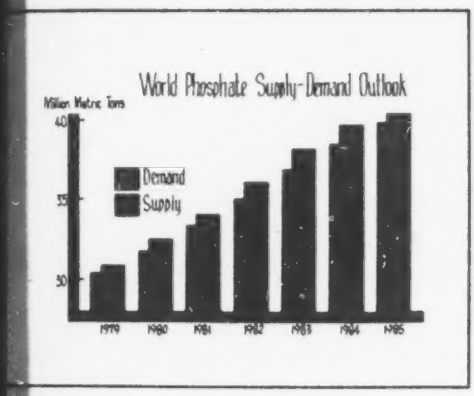
What is the supply/demand outlook, looking first at nitrogen?

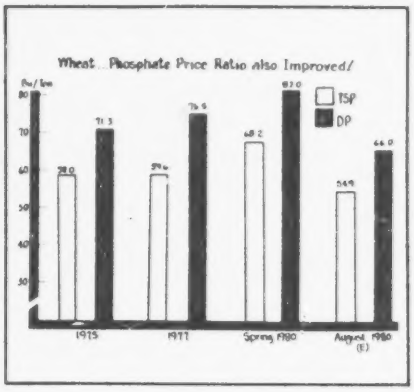
The bare statistics on numbers of plants coming on stream would indicate a significant worldwide surplus of materials in 1981 but statistics can be misleading. Much of the capacity cited is not real capacity; it's paper capacity. About 10% of the total world's production is based upon naphtha as feedstock. Those plants using naphtha or fuel oil as feedstock are paying $225/ton ammonia for the feedstock alone. The highest price I've heard recently was $180/ton ammonia in Europe, and it's certainly not that high here in the U.S. So you know that they won't be going all-out to produce ammonia in those plants, if they operate at all.

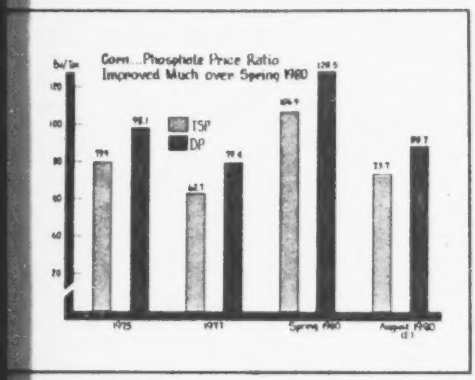
Another thing to be considered is the fact that much of the new capacity that is coming on stream is in the USSR. Even if Russia is able to produce the material, it is highly improbable that the world's logistics could be improved fast enough to make all this material available to the countries where it is needed.

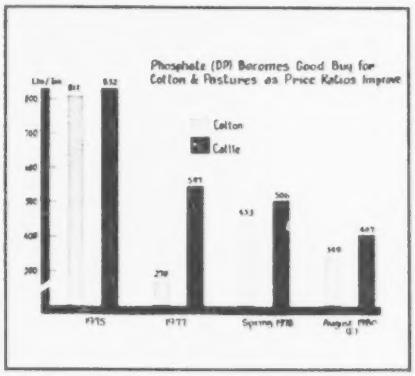
We can expect worldwide nitrogen demand to increase about 2½ to 3 million tons in 1981—if we can make it available. Supply will increase, but by no more than that—if as much. As a result, nitrogen will be in very tight equilibrium. The Iran/Iraq war has stopped the flow of some nitrogen, but this area accounts for only about 2% of the world's total production. If any other major nation should have a problem in production, we could have a severe shortage of nitrogen worldwide before the end of the year.

The U.S. nitrogen industry can well expect an all-time record in nitrogen sales in '81. In 1979–80 we surpassed the 11 million ton market for nitrogen









fertilizers for the first time in history. This fertilizer year we could well surpass 12 million, barring calamitous weather or other unforeseen catastrophic events.

On the supply side, in 1980 we produced an unexpectedly large amount of ammonia—18.8 million tons contrasted to only 17.2 million in 1979. This added production came about almost entirely by increasing the operating rate of the plants which were on stream. Only one or two of the plants which had earlier been closed because of economic problems were restarted. The net result was that those plants which were on stream operated at as high a rate of capacity as ever before in history. We cannot expect as large an increase during 1981 as that during '80.

Will some of the plants that have been mothballed be brought back into production?

There seems little economic reason whatsoever for a plant to open up as long as the price of ammonia stays as low as it is today. It's estimated that the average "spigot" production costs of ammonia now exceed $100/ton. And this figure doesn't include rate of return on investment or ammortization of the plant investment costs. With the cost of natural gas going up rapidly, we cannot expect additional plants to reopen as long as the price of ammonia on the Gulf Coast remains at or near its current level of $120.

What about supply/demand for phosphates?

It was clear in 1979 that the world supply/demand was coming to a very balanced situation. Then last spring we were faced with bad weather, high interest rates, and suddenly a sharp increase in phosphate prices. This decreased demand here and abroad; exports dropped and prices dropped. Beginning last fall, exports of diammonium phosphate (DAP), triple superphosphate, and phosphoric acid rebounded sharply. We are now exporting more phosphate than ever before. The first four months of the year we exported 20% more concentrated phosphates than we did last year, and last year we exported the most in our history. We exported 28% more DAP than we did in the first four months of the 1979–80 fertilizer year, and 114% more monoammonium phosphate. The future looks bright for export of all phosphates.

Last year farmers cut back on their fertilizer use, particularly phosphates. What do you think will happen this year?

I strongly believe that phosphate use will rebound and we will have an increase this year of 3–5% over the 1978–79 use level. We'll regain the tonnage lost in '79–80, plus an additional 3–5% in the amount of phosphate used.

With export demand high and a big increase in domestic demand, supply/demand is going to be in very close balance. If the embargo on shipments of P_2O_5 to Russia is removed and we start shipping phosphoric acid to Russia in addition to our other exports, we could easily run into a very tight situation on phosphate in late spring. If demand increases more than expected or if we should run into a major breakdown in a plant or two, we could run into a real shortage.

What's the situation in potash?

Canada is producing more potash than a year ago, but they are exporting at a rate 30% higher than they did last year. U.S. dealers did not take potash deliveries in the fall as rapidly as the previous year and as a result, the Canadians have been forced to ship overseas. By failing to follow a normal ordering pattern, dealers may find that they have been outbid by foreign users.

Last year it was clear, looking at the month-to-month statistics, that exports were being held down in order to insure enough material being available in the spring for the North American farmer. Exports all during the fall of '79 were held down artificially by the sellers. We know of several countries that did not get any potash that needed it, of several invitations for bid that were not answered. In the fall of 1980, since the North American user wasn't ordering, exports were up 25 to 30%.

With the increased production available in Canada and if we guess right about what is needed in North America and don't export too much, we should have ample supplies of potash available. But there will be nothing left over in inventory.

Summing up, what's your advice to dealers?

Be aware of the close supply/demand equilibrium. In my 30 years in the industry, I have never seen a time when all three plant nutrients were in as tight a supply/demand balance as they are today. The dealer should be aware that if he doesn't order now, he may have an extreme problem and delay in getting materials in the spring—if he gets them at all. The dealer is in a real dilemma; with the high interest rates, he has to worry about the cost of carrying materials for several months. He's going to have to do some careful planning, judge what he thinks his farmers are going to use, and order at least a portion of his materials now. It's a time for careful forward planning. He's going to have to look at the situation objectively and judge for himself how much he can afford to carry in inventory.

What's your advice for the producers?

Produce every ton of material you can. It'll be used! **FC**

SULFUR

THE best word to describe the sulfur market these days is "tight." "Tighter in real terms," says Bill Mason, sales manager for sulfur at Texasgulf, "than we've seen it for some time."

Why? "What we've been seeing in the sulfur market is a recurrence of problems such as rising shipping and production expenses and world crises, which have caused logistical shortages," says Mason. And at the same time, demand has gone up, led by the phosphate fertilizer producers (who account for 50% of U.S. sulfur usage) and the industrial sector.

Mason believes this tightness has come as somewhat of a surprise to many in the industry. A number of people had been under the impression that the recession would take its toll and free up a lot of product.

In a report before the Fertilizer Industry Round Table in October, D. W. Bixby, director of fertilizer technology research with The Sulphur Institute, summed up the early 1980 consensus: "The outlook in the U.S. for P_2O_5 consumption became more discouraging because of the tightening of credit, an unfavorable crop:phosphate price ratio, the Russian embargo, and bad weather. Since then, I understand matters have improved somewhat for the first two items."

So it would seem. As Mason points out, "The real effects of the recession in the U.S. were not as dramatic to the sulfur industry as one might expect. Demand has been good from both fertilizer and industrial sectors, but the real leader has been the strong demand by phosphate producers."

He sees two factors on the phosphate front that have kept demand so high. One, the replenishment of inventory in anticipation of high demand next year, and two, strong exports of finished phosphate products.

Bixby agrees that phosphate sales will probably be higher in the future. "My guess is that the positive effects of increased crop prices and high grain exports will offset the negative effects of the drought seen in large sectors of the U.S. and Canada and a decline in the total farm income in '80–'81 with a modest growth resuming in '81–'82."

It's Going To Cost *How* Much?

Inevitably a tight market has its effects on prices, so where will U.S. prices go? At this writing, Texasgulf very recently had announced a $12.50 increase in its contract sulfur prices—up to $140 per ton, FOB Tampa. How-

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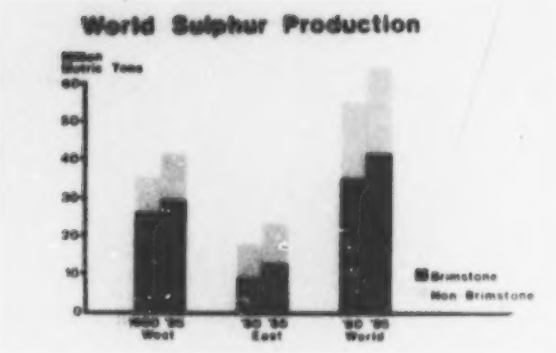

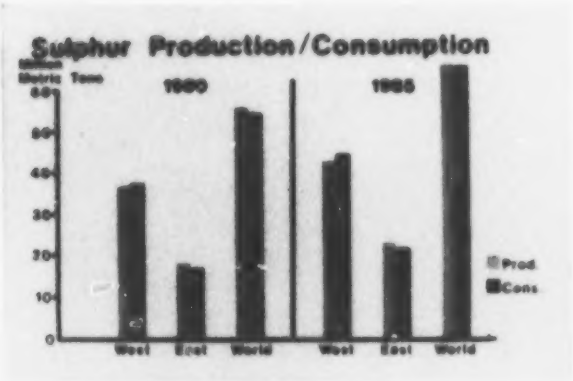

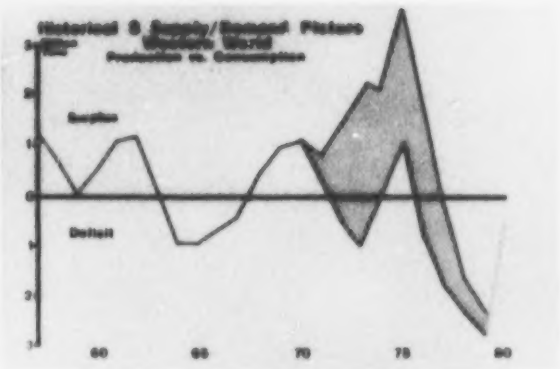

ever, neither Freeport nor Duval had as yet announced whether they would be chalking up similar increases. Still, there are probably few bets against further price hikes.

Sulphur, journal of the British Sulphur Corp., Ltd., in its July/August issue reported that "The factors pointing towards a general rise in contract prices . . . are unquestionable. Suppliers have been unable to meet heavy sulfur demands from present production levels and have continually drawn on stocks . . ."

While declining to reveal specific figures, Mason pointed out a few truisms that affect the pricing situation. "Sulfur is a cyclical commodity, and sensitive to supply and demand curves. Historically, prices must increase during times of peak demand. When demand is down, prices become flat; but you still have ongoing costs to cope with, which are now up."

Actually, Mason foresees little possibility for reduction in Frasch prices considering the "energy intensiveness of Frasch production. It's already costly, but I think the cost of producing, handling, and shipping sulfur is going to continue to rise."

Much of the upward spiral lies in natural gas, which is used in Frasch production as a fuel. Although Texasgulf, like other Frasch producers, has looked into the possibility of converting to coal as an alternative, "At the present time," reveals Mason, "the costs to convert our operations are just prohibitive." He expects that natural gas prices will have effects on sulfur prices in the future but allows the situation can't really be quantified at present.

The effect of all this on phosphate prices must be examined from a couple of vantage points. On the one hand, phosphates require a heap of sulfuric acid—89% for P_2O_5, and 50% for DAP. So, answers Mason, "I think the higher cost of sulfur will certainly have its effect on the attitudes of phosphate manufacturers."

On the other hand, upped sulfur prices will not *necessarily* translate to higher phosphate prices. "The fertilizer market has a set of factors that are independent of sulfur. So the prices don't necessarily go hand in hand," Mason points out. "Certainly, a reduction in the price of sulfur would not always translate into a phosphate reduction. There are a host of marketing principles and policies of all the companies in the country that have a bearing.

"However, I do think that the price of sulfur as a raw material going into phosphate production is a very definite factor that needs to be contended with, and it can't help but affect the attitude of the producers."

The Trade Off

Texasgulf president Dr. Gino Giusti, in a talk at The Fertilizer Institute's international marketing conference in June, presented figures on western world supply versus demand, and it looks as though tightness will be the watchword for years to come.

For 1979, he reports consumption of 38.4 million tons and production of 35.7. Five years hence, he estimates consumption will stand at 47 million tons compared with 42.6 million tons of production. And for 1990, consumption of 55 million tons is predicted, with production at about 49 million tons—a 6 million ton shortfall.

A quote from TSI's Dr. Bixby may be appropriate at this point. Prefacing his own forecast, he remarked, "The only thing certain about a five-year projection in sulfur supply and demand is that it will be wrong." He agrees with Giusti, though, that for the foreseeable future, demand will prob-

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ably continue to outstrip supply in the West.

"The key element of this shortfall for the industry," predicts Mason, "is going to come in inventory. Stockpiles—especially Frasch—have dropped significantly and are expected to continue to do so. In fact, during the first 6 months of 1980, U.S. inventory dropped in the range of 800,000 tons. By year's end (he was speaking in early December), it will be decreased by a total of about 1.4 million tons.

"What you're seeing is a total U.S. stockpile of roughly 3 million tons by year's end 1980. And since the U.S. consumes about 12 million tons a year, that means stockpiles are getting to be about 25%. I think that's a dangerously low level; and if they're reduced much further, we could be in a very, very dangerous position."

What then? For one thing, Frasch producers have increased exploration for new sources. Freeport has already begun production at a new mine at Caillou Island, LA. Remarking that the "deposit is a small one with a relatively short life," Freeport president R. L. Williams said, "Ordinarily it would not have been economical to mine this deposit." The go-ahead for the 350,000 ton per year operation came about because of improved sulfur prices "and the need to rebuild our inventories."

It appears the bulk of new production in the U.S. will likely be recovered sulfur—primarily from the Overthrust sour gas of Wyoming and from gas fields in Mississippi and Alabama. According to Mason, "Judging from preliminary indications, the Overthrust alone will probably produce in the range of 2–3000 tons a day when it comes on stream."

He postulates there may be as much as a 50–75% increase in recovered sulfur by 1982–83, depending on the new gas and on increased production from refineries that have cut back at present.

For the long-term shortfall, though, it's uncertain where the additional material will come from. However, Bixby sounds rather confident that new sources will rise to meet the need: "There is, after all, plenty of sulfur in the world . . . It will be obtained from pyrites and other compounds when economics justify it, but that day has not yet come."

Concerning pollution abatement sulfur: "Until 1990, it may do little more than replace declining . . . production, barring new discoveries."

The continuing (and imminent) hostilities in the Middle East are quite potentially a large rag in the gears of the western sulfur industry. "A prolonged war there," Mason reflects, "could cause very serious imbalance repercussions on the world sulfur trade. About 5% of the world sulfur supply comes from this area, and, of course, Iran provides natural gas to Poland for sulfur production. The interruptions there have already cut into productivity."

The wave of strikes that wrenched Poland in the summer apparently also have had a sizeable effect on the disposition of Polish sulfur. According to one source, the strikes, coupled with the cutoff of Iranian supplies, may result in Poland's being able to export only 20–25% of a potential 4 million metric tons.

One outcome of the crisis situations has been that certain markets traditionally supplied from the Middle East have turned to North America for their sulfur supplies. Thus far, Canada and the U.S. have done a good job of meeting these needs. Last year's million ton shortfall from Iran and Poland was made up by removing 1.3 million tons from inventory, 1.1 million of which came from U.S. Frasch producers.

In any event, some industry voices believe that only the alleviation of the Middle East crises can prevent serious imbalances in the future. **FC**

Why Sulfur Demand Is Increasing

DR. SAMUEL TISDALE, president and chief agronomist at the Sulphur Institute, thinks U.S. and Canadian farmers will use sulfur in greater quantities as deficiencies of the nutrient become more apparent.

"Two decades ago, sulfur deficiencies had been identified in 13 states," says Tisdale. "By 1978, the number had grown to 35, and every Canadian province from Ontario west was reporting deficiencies of this vital nutrient.

"If today's need for sulfur is any indication of the anticipated demand," he continues, "I think we'll see a dramatic increase in the use of sulfur fertilizers in this decade."

"Sulfur, while not usually ranked as a macronutrient, is equal in importance to N and P in the formation of protein," says Tisdale. "Many crops require as much S as they do P for maximum yield; some require more."

Tisdale explains that most commercial fertilizers used before the 1950s contained large amounts of S as impurities. Ordinary superphosphate, with 12% S, and ammonium sulfate, with 24%, were two of the most widely used sources of P and N. In effect, growers were getting significant amounts of S in their normal fertility programs. Today, however, agriculture relies primarily on much higher analysis sources of N and P, most of which have little or no sulfur. Even the reduced usage of sulfur-rich feedlot manure has played a role.

As a result, in the past 30 years, total S as a percent of NPKS plummetted from 31.3% to less than 6%.

While additions of S to U.S. and Canadian crop soils have been decreasing over that time, the removal of S from the soil has been going the other way. Average corn yields during this 30-year period have approximately doubled, and for every 150 bushels of corn harvested, 27–33 pounds of S are harvested, too. Cotton, tobacco, grain sorghum, alfalfa, clover, many grass species, sugar beets, and a variety of vegetable and fruit crops remove even greater amounts of S from the soil. Even with wheat, which has a relatively low sulfur content, 9–12 pounds of the element are removed from the field when a grower combines a 40 bushels-per-acre crop.

Like other traditional sources, atmospheric sulfur is providing less S to agricultural lands than in the past. From 1970 to 1975, EPA measurements showed a 30% decrease in the levels of sulfur dioxide released into the air over urban areas. Sulfur oxide emissions from all sources were down by 4%.

"No one is suggesting that sulfur oxide pollution be allowed to increase in order to improve crop yields," Tisdale says. "These pollutants can be corrosive and poisonous. The point is that farmers in all regions should be aware of how the control of sulfur oxide pollution and the absence of S in high-analysis fertilizers can short their crops on this vital plant nutrient.

"There are a wide variety of S fertilizers available at costs far below those for N and P," he points out.

In areas where the nutrient is needed, farmers can expect a $4–$10 return in yield on every dollar invested in sulfur, Tisdale adds. **FC**

For Details Circle No. 109 on Postcard

'81

K_2O Faces a SQUEEZE

During the next five years, the supply: demand ratio for potash will go from tight to tighter, claims an industry expert.

ORDER your potash early and don't expect price reductions because the market probably will be tight. That's the advice of Dean R. Gidney, Potash Co. of America, while making what he calls his "stock annual plea to take deliveries of potash and other materials as soon as possible" at the annual meeting of the Fertilizer Industry Round Table. But is it even more important to heed his advice this year than it was in the past?

"In looking forward to the current fertilizer year, we don't see any reason to expect very much change in the tight supply/demand balance," Gidney explains. "With the usual qualifications concerning weather, farm income, farm prices, etc., we foresee a good domestic season in 1980–81."

Anticipating a demand for increased deliveries this spring, he continues, "We will be faced with the usual logistic problems. Even despite the fact that there will be an adequate supply of potash, you will once again be faced with the unavailability of some grades at some times and places."

A veteran forecaster, Gidney has been making annual predictions since the 1940s when, as he describes it, the fertilizer industry was "an industry of manure and kainite." Over the years he has been more on target than off.

In 1958, for instance, he predicted that China would be a large potential market in 20 years. Today that country is holding 3-year contracts for 650,000 tons from Canpotex; 100,000 tons from Western Europe; 160,000 tons from PCA; and is rumored to be negotiating with Spain. Gidney thinks this indicates demand will grow even more dramatically, making his 1984–85 Asian predictions too low. (See Table.)

Other countries, too, are closing the gap between supply and demand at such a rate that Gidney believes the industry should have a "knife-edge balance" by 1984–85.

Who Supplies, Who Demands?

As far as production is concerned during the next 5-year period, Gidney believes the major increases will be in Canada and the USSR, although he does not think the Russians will meet their stated goals. (His table reflects this, and the figures are his own.)

Capacities in Saskatoon will be expanded, and PCA's new mine in New Brunswick will be producing perhaps as early as next year, coming close to rated capacity in 1983. He suspects the Denison/Potacan project, also in New Brunswick, will become productive at least a year later.

In addition, he says, "Minor increases in capacity are in process at three of the private industry companies in Saskatoon (PCA, Kalium, and Cominco), and the Potash Corp. of Saskatchewan has announced its intention to make major expansions over the next decade. The major expansion at the Lanigan mine of approximately 1 million metric tons of K_2O will be completed by 1983, and an entirely new mine at Bredenbury is expected to produce 3.6 million short tons a year of potassium chloride by 1985—that's approximately 1.95 million metric tons of K_2O." If all comes to fruition, he points out, the figures on his chart for North America would be short by at least a million metric tons of K_2O.

Off the North American continent, he foresees European capacity strengthened from the Dead Sea works in Israel, possibly operative by the end of 1981. Jordan's mines in the Dead Sea area may be productive by 1983. With the help of technical advisors from France, Brazil's mine in the state of Sergipe may be in operation by 1984–85.

The largest consuming areas of potash, according to Gidney, will continue to be its producing areas, and in the direct order of the amount of production: Eastern Europe, North America, Western Europe. Other markets, says Gidney, must be developed and increased.

In Asia, Japan and India should continue as good consumers, while Korea and Taiwan rapidly expand their demands. As previously stated, the PRC has entered the picture. In Latin America, Brazil remains the principal consumer.

"We recognize the fact that Brazil has serious economic and monetary problems," explains Gidney, "but agriculture is as important to Brazil as it is to the U.S.A. Export crops are essential to the Brazilian economy, and virtually every cash crop in Brazil is a large user of potash. For this reason, we believe that some solution to the payment problem must be worked out and foresee a continuing expansion in that market."

Gidney reiterates a point he makes annually along with his predictions, "The potash market is a *world* market, and it is *world* supply and demand which determines the potash balance."

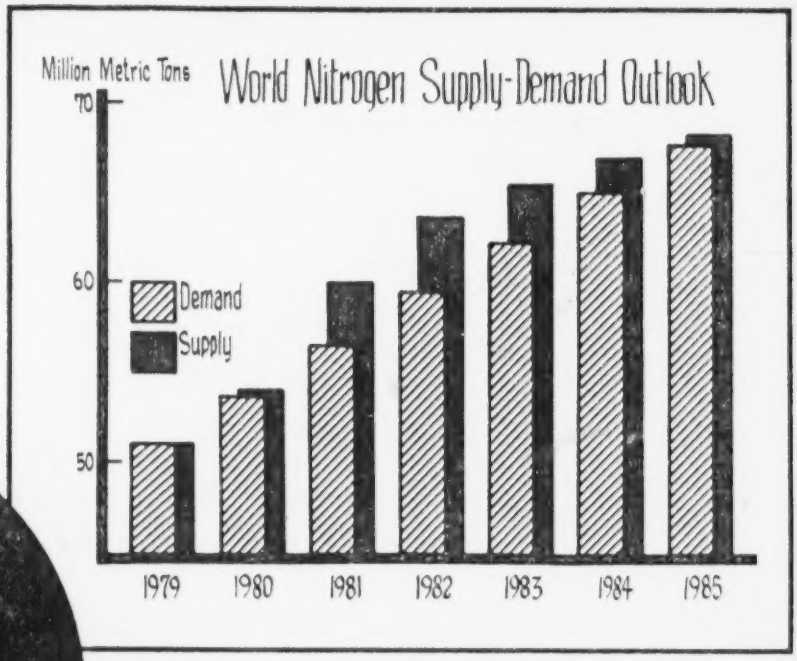
For this reason, he stresses, "We must increase the potash consumption in other of the lesser developed countries in the world. But this is a slow process contingent upon education and financing, and it is in the area of education that the potash industry takes its greatest pride." FC

1984/85 Estimated World Production and Consumption of Potash (1000 Metric Tons K_2O)

	Production	Consumption	Surplus (Deficit)
North America	11,800	7,500	4,300
Western Europe (inc. Israel)	6,800	6,800	—
Eastern Europe	14,000	12,400	1,600
Latin America (1)	400	2,400	(2,000)
Asia & Oceania	200	3,400	(3,200)
Africa Mideast (2)	500	600	(100)
TOTALS	33,700	33,100	600

(1) Includes potential production in Brazil.
(2) Includes anticipated production in Jordan.

'81 NH_3 OUTLOOK at a GLANCE



Summary...World Situation...1981

Demand.....Increase as expected by 2.5-3.0 million tons

Supply.....Increase...but not nearly as much as capacity statistics would indicate

Supply-Demand Balance.....Tight equilibrium

At the Fertilizer Industry Round Table in late October, Dr. John Douglas of TVA presented this analysis of the situation in nitrogen. He predicts there'll be increasing pressure on all nitrogen supplies once we get into the spring, with some probability of spot tightness or even shortages.

Export-Import Picture...U.S...1000 Tons

1979

Net Exports...About 200

1980

Exports Increased...About 100

Imports Increased ...About 400

Net Balance.....<100 Net Imports

1981 Projection

Exports.....Increase 8-10%

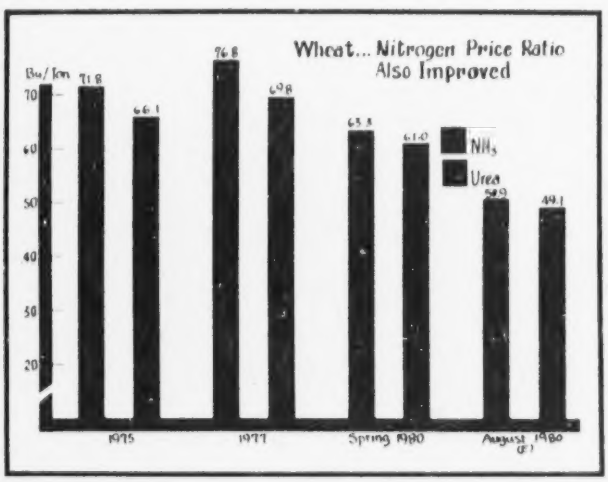
Imports.....Increase NH_3 by 500 decrease other imports

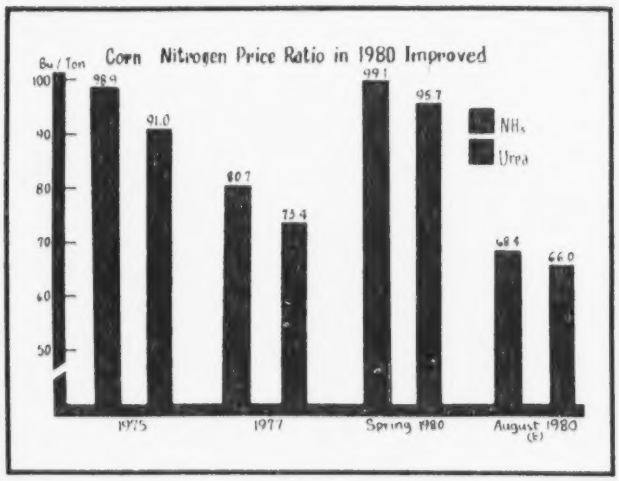
Net Trade Balance.....0 ± 250

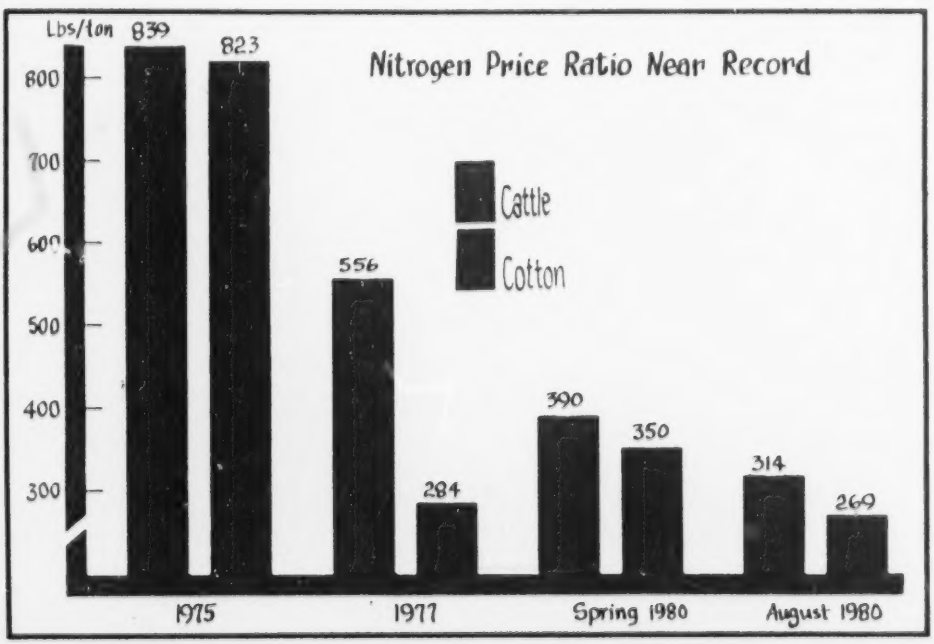
For 10% of Worlds Production Feedstock Costs more than NH_3

Nitrogen...Supply-Demand Summary 1981

- Supplies ample
- Domestic demand, up, but fall of 1980 may be slow
- Export demand should increase for urea and nitrogen solutions
- Generally tight situation after slow fall
- Increasing pressure on supplies after fall 1980







Feedstocks:

SUPPLY and demand—usually without one, the other suffers. Paradoxically there is an overadequate supply to meet the demand for one product this year, yet that product is more costly than ever before.

The product is natural gas, vital to the chemical industry which uses 11% of the total U.S.-consumed 20 trillion cubic feet annually. The supply is abundant and "overdeliverable" if anything, says the American Gas Association. But because the chemical industry and residential customers have cut their total gas demands 22.1% and 13.6% respectively, natural gas prices will continue to rise—as much as 20% per year over the next few years, predicts DuPont, and perhaps 25% in the Midwest and California.

It is understandable then that industry is looking for alternate feedstocks.

National Distillers and Chemical, parent company of U.S.I. Chemicals and Emery Industries, has been long involved with producing ethanol through a fermentation process. Before 1950 the alcohol produced provided the major feedstock for several chemicals, and the company hopes this practice will be revived.

National owns 16% of Cetus, a genetic engineering firm, and the two have developed a continuous fermentation process. National chairman Drummond C. Bell foresees considerable savings over the traditional batch method because energy demand would be reduced by running the process at a constant temperature.

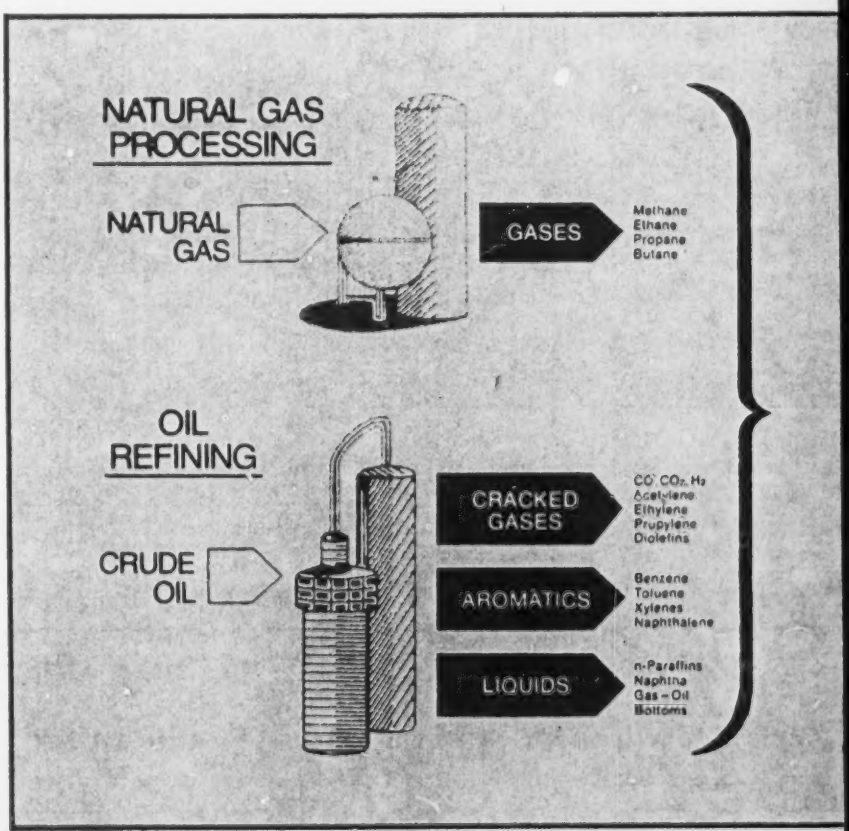
When pilot plant production begins this year, the feedstock will be corn starch; but by 1983 when commercial production is slated to start up, the feedstock could be cellulose or municipal waste. Adds executive vice-president Clifford Oman, head of National's chemical operations, if successful the process will free expensive ethylene for other uses.

"During the 1980s we are going to see very slow development," concedes Bell. "The 1980s will be the syn gas (for synthetic gas) decade. The 1990s will see an explosion of DNA technology." Operational problems are the reason for slow progress, but the recent development of a low-pressure, low-density process may help to make National more competitive.

Syn Gas: Getting the Nod?

H. A. Sorgenti, president of Arco Chemical Co., agrees that syn gas is coming into its own, though not so quickly. He explains that in theory any organic can be built from synthesis gas, but in practice oxygen-containing intermediates "will get the nod." Three syn gasses are already commercially successful (methanol, acetic acid/acetic anhydride, and 2-ethylhexyl alcohol) and five more have high potential (ethylene glycol, adipic acid/caprolactam, terephthalic acid, methyl methacrylate, and vinyl acetate).

However, Sorgenti finds there are limits for syn gas chemistry. "We al-



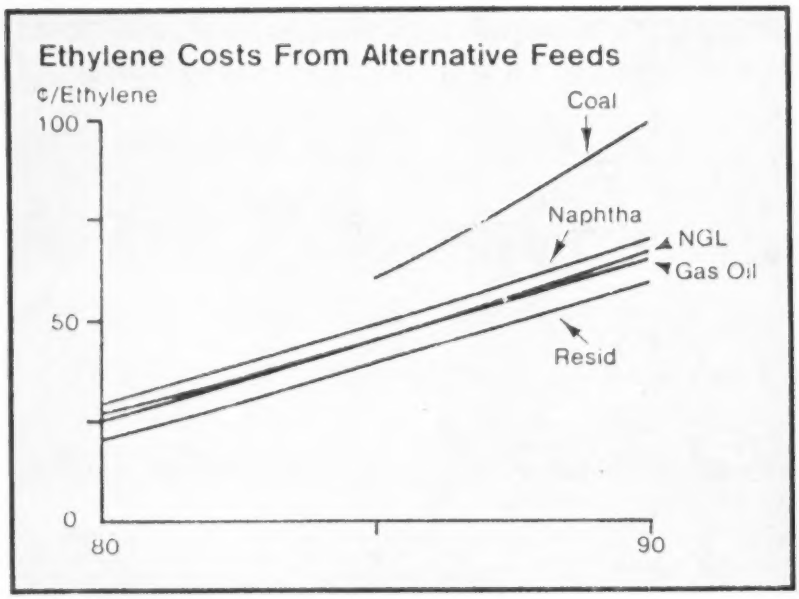
This chart, produced by Exxon Corp., shows the dependence of fertilizers and pesticides on petrochemicals.

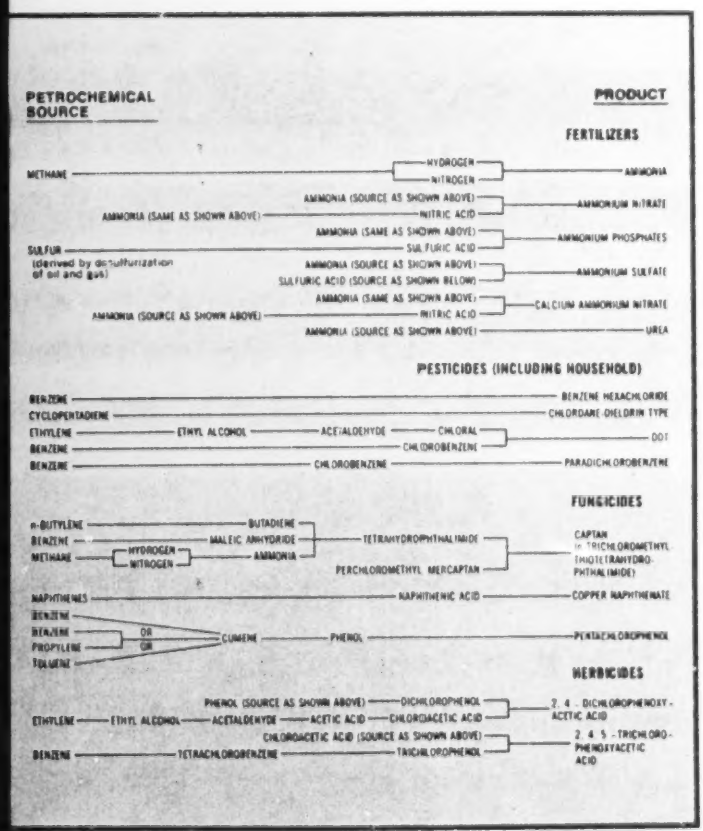
A Decade of Change

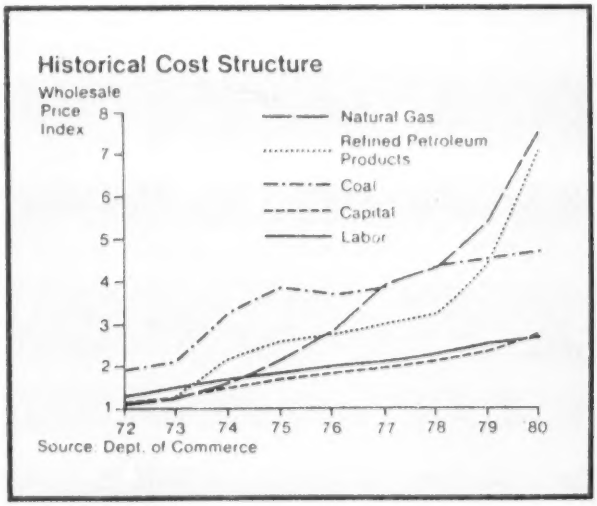
As natural gas becomes more plentiful and more expensive, industry searches for a viable substitute.

ready use synthesis gas for methanol and oxo-alcohol production. In each of these, there is a 100% theoretical yield of raw material, both carbon and oxygen. This points to a key consideration for chemicals which will be the likely economical uses of syn gas. In ethanol, ethylene, and benzene, a major portion of the feed mass is lost as water. This is a tough penalty which I doubt can be overcome," he explains.

He believes that syn gas will be made economically from coal only after "a significant breakthrough." Pointing out that the high level of research activity in industry today "creates the potential" for this breakthrough, Sorgenti says for the present "the cost of syn gas from coal is above the value of methanol. The syn gas cost is driven there, despite lower feedstock cost, by the high capital







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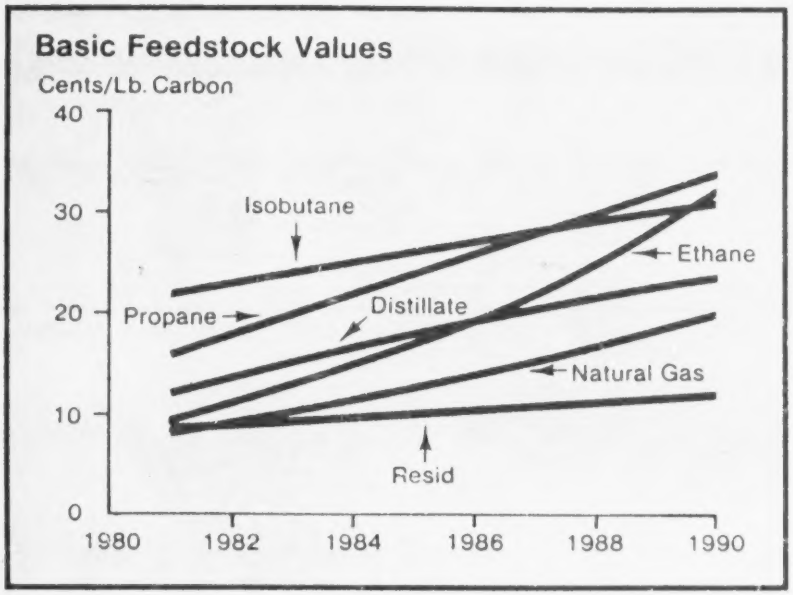

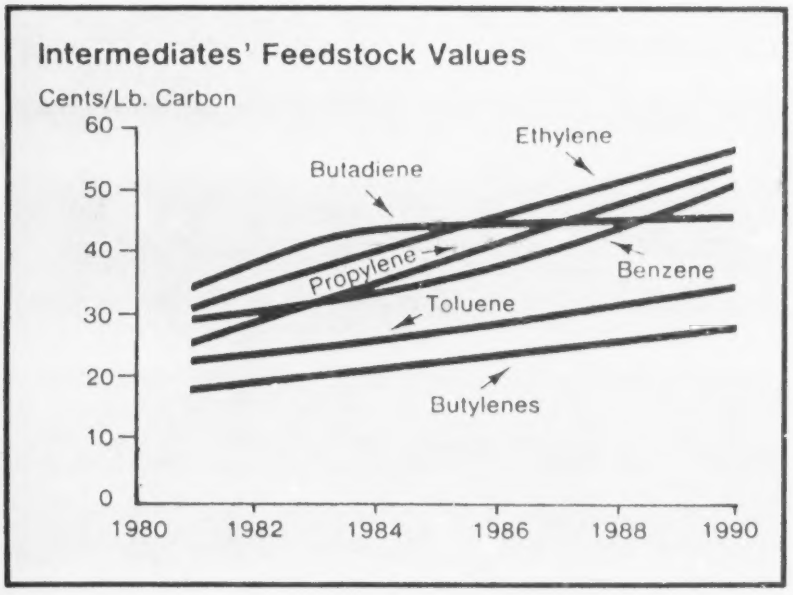

charges associated with synthesis gas made from coal.

"We are looking at the early 1990s before a full fledged syn gas industry based on coal could begin to be an important factor," he continues. "Our own methanol plant (200 million gallons) is based on natural gas. We expect with time to shift the synthesis gas portion of this plant to natural gas liquids, naphtha, or resid, and finally coal."

Note that Sorgenti does not predict a "rapid shift away from petroleum and natural gas as a source of feedstock for organic chemicals." He explains, "Although the cost of energy, and hence our feedstocks, has risen dramatically, our industry consumes only 5% of today's total energy demand. By 1990, this figure will only be about 8%. At the same time, you are all familiar with the relative value of fuels to the organic products we make. The economists tell us we should win the battle for these raw materials.

"Conversely, this says the adjustments in the use of crude and natural gas caused by these relative shifts in value are more likely to occur on the fuels side. Just think about it for a minute. Isn't this what you have already seen? How many power plants have already been converted to coal? Higher MPG requirements for autos and lower gasoline demand are a response to higher fuels costs. The trend is established and observable. We see coal usage equivalent to 11 million barrels per day by 1990, and almost all of it will be for its most efficient use—fuel."

Predicting trends in costs of basic feedstocks, Sorgenti says, "Heavy feedstocks will become cheaper relative to other sources of carbons, particularly natural gas liquids, in an increasingly free market. Both of these conventional sources of hydrocarbons, however, will remain the basic source of organic chemicals throughout the remainder of the century.

"Different views of relative feedstock values are possible, but we can agree that all feedstock values will be increasing. Therefore, the real challenge is to use these feedstocks as efficiently as possible."

Again, looking ahead, Sorgenti emphasizes, "We have not suggested any radical changes. The really significant potential for shifts in feedstock in the next 20 years will most likely come in the stages of production after the basics. The basic chemicals, olefins and aromatics, are themselves feedstocks. Butylenes, butadiene, and toluene will offer significant cost advantages over the next decade. Innumerable opportunities will present themselves for improved and new processes.

"The next 10 years will be a process engineer's delight. Processes which are simpler, utilize lower cost feedstocks, give higher yields even at the expense of higher capital, give greater flexibility in feedstock, give lower energy consumption, and yield purer products will be favored. These will be the major structural changes which are likely to occur as the industry tries to make better use of more precious feedstocks." FC

Pollen Product Prospers Plants

JOHN YOPP, a plant physiologist at Southern Illinois University, Carbondale, believes a lab copy of a powerful plant steroidal lactone found in pollen could help growers "dramatically increase" yields. The modified steroid—known in its natural form as brassinolide—seems to influence root growth, fruit set, and "just about all aspects of plant growth."

The modified steroid, part of a group of plant chemicals called brassino steroids, occurs naturally in the pollen from rape blossoms. Although discovered in the 1940s by USDA scientist John Mitchell, development of the chemical was hindered by criticism from other researchers and the fact that the steroid occurs naturally only in very small quantities.

"You get only a few milligrams from a hundred pounds of pollen," says Yopp.

He notes that brassinolide appears to act with auxin, a naturally-occurring plant hormone, to produce the increased growth. The two compounds seem to potentiate, increasing the effect of auxin many hundredfold.